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Development of Indian Major Carp Fry Raising Techniques in Creeks of Kaptai Lake, Bangladesh

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Abstract: Experiments for evaluating growth, survival and production performance of Indian Major Carp (IMC) fry were conducted in three creeks of Kaptai Lake *viz*., Islamabad, Hazachara and Vaittapara of Bangladesh for a period of eight weeks. Five-days-old IMC hatchling was stocked at a rate of one million/ha in all the three creeks and the feasibility of IMC fry raising was checked. Results indicated a significant spatial variation in specific growth rate (SGR) of IMC fry despite uniform stocking densities, attributable to variation in environmental parameters. Rohu was found to have comparatively higher SGR of 2.92±0.86 in Hazachara whereas Vaittapara creek was reported with higher SGR of 3.17±0.64 for mrigal. Islamabad creek was found to be conducive to catla with a SGR of 3.71±1.91. In general, higher gross and net productions of IMC fry were reported from Vaittapara creek, suggestive of its suitability for developing IMC fry raising techniques. Findings from the present study might have important implications for enhancing fish production and in designing economically viable IMC seed production under polyculture management in Kaptai Lake.

Key words: Carps · Cost-Benefit Analysis · Inland Fishery · Kaptai Lake · Polyculture

INTRODUCTION

The inland fisheries recources of Bangladesh are among the richest in the world, contributing 80.59% of the country's total fish production [1]. Encompassing an area of 68,800 hectares, Kaptai Lake is one of the important inland water resources of Bangladesh. Commercial fishing in this lake started with 1200 MT in 1965-66 and has reached up to 8,248 MT in 2007-08 [1]. However, now-a-days, the contribution of Kaptai lake fisheries to the inland fishery is largely limited with unwanted species. The most valuable Indian Major Carp species (IMC) *viz*., Rohu (*Labeo rohita*), Catla (*Catla catla*), Mrigal (*Cirrhinus cirrhosus*), Calibaush (*Labeo calbasu*) and Mohasoal (*Tor tor*) have declined devastatingly from 81% during 1965-1966 to a meager 4% in 2007 and in contrast, low valued small forager fish *viz*., Kechki (*Corica soborna*), Chapila (*Gonialosa* spp.), Pabda (*Ompok pabda*) etc. have boomed to about 92% in 2007 from 3% in 1965-1966. In spite of the stoking of huge number (60 million) of IMC fingerlings in the Lake every year, alarming decrease of their population could probably be due to environmental hazards and management shortfalls [2]. Recent findings of Bangladesh Fisheries Research Institute (BFRI) indicate cage and pen culture could be feasible and profitable in Kaptai Lake. It is estimated that pen culture alone in the lake can produce an additional quantity of 3,200 tons of fish and simultaneously this can provide livelihood opportunities to the local residents.

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The objectives of the study were to determine the growth, survival and economically viable methodology of IMC seed production under polyculture management.

MATERIALS AND METHODS

Study Area and Creek Preparation: Experiments for evaluating growth, survival and production performance of IMC fry were conducted in three creeks: Islamabad, Hazachara and Vaittapara of Kaptai Lake, Bangladesh for a period of eight weeks. Creeks were constructed by fencing off the mouth with small meshed knotless polythene net filled with reservoir backwaters. Fence was built using bamboo, nylon twine and rope, polythene lining and sand bags. For convenience in netting, submerged timber and weeds were removed from the creeks.

Fry Collection and Stocking: Fry of IMC obtained from Raipur Government Carps Hatchery, Laxmipur, Bangladesh was used for experimental purpose and five-days-old hatchling was stocked (1 million/ha) in three creeks: Islamabad creek, Hazachara creek and Vaittapara creek.

Feeding and Management: The fry was provided with supplementary diet comprising conventional mixture of rice bran (50%) and mustard oil cake (50%) in equal proportion by weight. Feeding was done four times the total body weight of initial biomass of spawn during initial five days followed by eight times in subsequent days, by broadcasting the mixture in two rations during morning (7-8 AM) and afternoon (4-5 PM).

Sampling: Sampling was done using fine mesh size net every 15 days from each treatments and growth parameters *i.e*., length (cm), weight (g) and health condition were estimated precisely.

Fry Harvesting: Final harvesting of fry was carried out on 60^{th} day of rearing (8 weeks trial) by repeated netting. Specific growth rate (% body weight day^{-1}) was calculated using the formula of Day and Fleming [3], $SGR= [ln\ WT_f - ln\ WT_i] \times 100/T$, where WT_f is the average final fish fry weight (g), WT_i is the average initial fish fry weight (g), T is the duration of the experiment (days) and *ln* is natural log. Survival rate was calculated using the formula of, survival rate (%) = [number of fish fry at the end of the experiment/number of fish fry at the start of the experiment] x 100. Mean growth (length, cm and weight, g) was recorded by taking average of random samples from each creek.

Studies of Water Quality and Environmental Conditions: Water quality parameters were estimated fortnightly by using HACH water testing kit (Model FF-3, USA) and extent of availability of natural food was checked each month with a help of Secchi disc reading. Primary production of surface water was measured to find out the probable linkage with monthly growth performance and yield.

Economic and Statistical Analysis: Data with respect to fish growth, production and feed utilization efficiency were analyzed and ANOVA, DMRT and regression analyses were carried out for significance test. Economic viability was assessed through financial analysis of the whole expenditure.

RESULTS

Hydrographical Parameters: Hydrographical parameters of three creeks were within permissible limits as well as suitable for aquatic lives (Table 1). Water temperature (°C) was showed a direct relationship with air temperature. pH found to be alkaline throughout the study period. Free CO_2 (mg/l) was ranging between 2.34 and 4.89, total alkalinity (mg/l) was between 52.82 and 85.4, total hardness (mg/l) was between 38.3 and 77.6; transparency (m) was between 0.98 and 2.38 and dissolved oxygen (mg/l) was between 4.35 and 7.88, suitable for survival of fish fry.

Growth Performances: Details corresponding to growth, survival and specific growth rate and details of carps fry under different treatments over the eight week experiment are summarized in Table 2. Among the three creeks, Vaittapara creek was reported with higher growth rates of rohu and mrigal fry. A significant spatial variation in specific growth rate (SGR) of IMC fry was evident despite uniform stocking densities, attributable to variation in environmental parameters. Rohu was found to have comparatively higher SGR in Hazachara (2.92±0.86) whereas Vaittapara creek was reported with higher SGR (3.17±0.64) for mrigal. Islamabad creek was found to be conducive to catla with a SGR of 3.71±1.91.

Table 1: Hydrographical parameters (Mean±SD) from the three studied creeks of Kaptai Lake, Bangladesh

	Hydrographical parameters (Mean ± SD)						
Creek	Temperature (°C)	pH	CO_2 (mg/l)	Total Alkalinity (mg/l)	Total Hardness (mg/l)	Transparency (m)	DO (mg/l)
Islamabad	27.09±5.89	6.9±0.52	2.92±0.60	59.45±6.71	43.08±5.51	1.94±0.57	6.40±1.51
Hazachara	29.03±3.10	7.8±0.51	3.02±0.52	70.3±6.45	65.5±4.31	1.82±0.65	5.67±1.42
Vaittapara	29.73±2.2	7.6±0.62	3.83±1.08	80.7±5.86	71.2±7.5	1.52±0.60	6.62±1.08

Table 2: Growth performances of carps fry under polyculture management after eight weeks of rearing in three different creeks with similar stocking density at 1 million/ha based on one-way ANOVA

			After 30 days		After 60 days			
Creek	Creek size (hectare)	Carp species	Length (cm)	Weight (g)	Length (cm)	Weight (g)	Survival rate (%)	SGR(%/day) at 60th days
Islamabad	1	Rohu	3.50^{b}±0.78	2.43±0.45	5.94±0.86	5.29±0.96	75	2.61±0.87
		Catla	4.65±0.73	2.60^{b}±0.45	7.27±2.89	9.63±8.98	65	3.71^{a}±1.91
		Mrigal	3.49±0.88	2.24^{b}±0.50	5.45±1.17	4.89±0.77	71	2.64^{b} ±0.88
Hazachara	1.1	Rohu	3.49^{b} ±0.73	2.49±0.75	6.37^{b}±0.62	5.85^{b}±0.87	74	2.92±0.86
		Catla	4.18±1.39	3.21^{a}±0.72	7.27±1.71	6.55±1.74	69	2.35^{b}±1.00
		Mrigal	3.49±0.81	2.43^{ab} ±0.32	6.16^{b}±1.10	5.96^{b}±0.94	73	2.98^{ab}±0.50
Vaittapara	1.2	Rohu	4.14^{a}±0.78	2.76±0.60	7.74^{b}±1.01	6.47^{a} ±0.84	67	2.90±0.68
		Catla	4.15±0.90	2.87^{ab}±0.54	7.93±1.33	7.19±1.40	70	3.06^{ab}±0.78
		Mrigal	4.05±0.90	2.62^{a}±0.48	7.80^{b}±0.89	6.67^{b}±0.68	68	3.17^{a}±0.64

a, b and ab superscripts; means with the different superscript within the same column are significantly different ($p<0.05$).

Table 3: Average survival, gross production, net production and production of IMC fingerlings under polyculture management

	Creek		
Parameters	Islamabad	Hazachara	Vaittapara
Survival average (%)	70.3	72.00	68.3
Gross production (kg/ha)	2,343.3	2,640.00	2,732
Net production (kg/ha)	2,340.8	2,637.25	2,729
Production of fry (No./ha)	703,000	792,000	819,600

Table 4: Cost-benefits analysis

	Creek		
Items	Islamabad	Hazachara	Vaittapara
A. Cost			
Creeks lease (Tk. 25,000/ha/yr)	4,166.00	4,583.00	5,000.00
Lime (Tk. 20/kg)	5,000.00	5,500.00	6,000.00
Cow dung (Tk. 7/kg)	14,000.00	15,400.00	16,800.00
Sumithion/insecticide(Tk.1300/1L)	3,250.00	3,575.00	3,900.00
Rotenone (Tk. 300/Kg)	2,250.00	2,475.00	2,700.00
Hatchlings (Tk.10,000.00/million)	10,000.00	11,000.00	12,000.00
Feed			
Wheat flour (Tk. 35/Kg)	1,412.00	1,540.00	1,652.00
Mustard oilcake (Tk. 45/Kg)	14,125.00	15,250.00	16,960.00
Rice bran (Tk. 20/Kg)	10,500.00	11,560.00	12,600.00
Labor (Tk. 260/day)	28,600.00	28,600.00	28,600.00
Harvesting	20,000.00	20,000.00	20,000.00
Miscellaneous	5,000.00	5,000.00	5,000.00
Total cost	118,303.00	124,483.00	131,212.00
B. Gross benefit			
Fry	703,000.00	792,000.00	819,600.00
Net benefits (B-A)	584,697.00	667,517.00	688,388.00

*Tk., Bangladesh Taka (1 US$ = Tk. 80.00). ** Price of fry was Tk. 1.00/individuals (T_1, T_2 and T_3).

The gross and net productions (kg/ha) of IMC fry after eight weeks of rearing were 2,343.3 and 2,340.8; 2,640 and 2,637.25; 2,732 and 2,729 in Islamabad, Hazachara and Vaittapara respectively. However, gross and net productions varied among the creeks (Table 3). Despite this, maximum number of fry per hectare was produced in Vaittapara (819,600), followed by Hazachara (792,000) and Islamabad (703,000) (Table 4). Total cost of production (Tk/ha) of Islamabad, Hazachara and Vaittapara was 118,303, 124,483 and 131,212 and the net benefit (Tk/ha) was 584,697, 667,517 and 688,388 respectively (Table 4).

DISCUSSION

Physicochemical parameters play a significant role in the maintenance of a healthy aquatic environment and production of natural food organism. Growth, feed efficiency and feed consumption of fish are normally governed by environmental factors [4]. Water temperature (°C) was found to be in the range of 21.8-32.6 in the experimental creeks which are within the acceptable range for nursing of fry and fingerlings of warm water fishes that agree well with the findings of Haque *et al*. [5], Kohinoor *et al.* [6] and Rahman *et al.* [7]. Consistent higher transparency from Vaittapara could be attributed to the reduction of the plankton population by higher density of fish Haque *et al*. [5]. Dissolved oxygen level was found to fluctuate from 4.35 to 7.88 mg/l in the experimental creeks' Saha *et al*. [8], Ahmed [9], Rahman and Rahman [10] and Rahman *et al.* [11] also reported similar trends of dissolved oxygen in various carp nursery ponds. Fluctuations in DO concentrations might be due to alteration in the rate of photosynthesis [12]. However, the DO level was within the acceptable range for fry rearing in all creeks. The observed pH values agree well with the findings of Kohinoor *et al.* [6], Chakraborty *et al.* [13] and Rahman *et al.* [11] and are within the range of good water quality for rearing of fry/fingerlings in nursery pond. The alkalinity or acid combining capacity of impounded waters in generally caused by carbonates and bicarbonates of calcium and magnesium combining with dissolved CO_2. These carbonates and bicarbonates form an equilibrium which plays an important role in the productivity of the system. Total alkalinity levels (52.82 mg/l to 85.4 mg/l) indicating the productivity of the ponds was medium to high [14]. The findings of the present study are in agreement with those of Islam [15, 16], Rahman and Rahman [10] and Rahman *et al.* [11, 17].

Catla fry was reported with significantly ($p<0.05$) higher SGR (3.71±1.91) from Islamabad creek after a period of eight weeks. Stocking density had previously been observed to have a direct effect on the growth of fish (Jannat *et al.* [18]; Haque *et al.* [5]; Kohinoor *et al.* [6], Islam, [16]; Islam *et al.* [15]; Rahman and Rahman, [10] and Rahman *et al.* [11, 17]. But the present study deals with uniform stocking densities in each creeks and spatial variation were observed in specific growth rate (SGR) of IMC fry.

Higher gross and net productions of IMC fry were reported from Vaittapara creek, suggestive of its suitability for developing IMC fry raising techniques. The results in the experiment are very close to those of Saha *et al.* [8] who obtained a gross production of 1385.15 to 1995.60 kg/ha by eight weeks rearing of rohu (*Labeo rohita*) fry at 0.6 to 0.8 million/ha stocking densities. Rahman and Rahman [10] also found 1663.48-2476.77 kg/ha productions after 8 weeks nursing of local sharpunti (*Puntius sarana*) hatchlings at stocking densities of 1.25 to 1.75 million/ha. Rahman *et al.* [17] obtained a production of 1869.1 kg/ha by rearing of *Labeo calbasu* fingerlings for eight weeks at a stocking density of 0.8 million hatchlings/ha.

CONCLUSION

Findings from the present study might have important implications for enhancing fish production and in designing economically viable IMC seed production under polyculture management in Kaptai Lake.

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